

# Comparison of GB and ASME Standards

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# Comparison of GB and ASME Standards

- GB= Guojia Biaozhun ( National Standard in Chinese)
- SY = Shi You (Petroleum)
- JB = Jian Biao (Construction Standard)
- GB/T = T : Tuijian (recommended GB)
- HG = Hua Gong (Petro Chemical)

# Comparison of GB and ASME Standards

- GB 150-89 : For Design Pressure  $\leq 35$  MPa ( latest issued on March 20, 1998).
- ASME VIII- Div 1: DP up to 20 MPa
- ASME VIII- Div 2: DP up to 70 MPa
- ASME VIII- Div 3: DP above 70 MPa

# Comparison of GB and ASME Standards

- Factor of Safety
- GB 150-89 : 3.0 for carbon steel, low-alloy steel, high alloy steel vessel
- ASME VIII Div 1: 3.5 for carbon steel, low alloy steel
- ASME VIII Div 1 : 3.0 for High alloy steel
- Note: ASME VIII Div 2: Factor of safety is 3.0

# Comparison of GB and ASME Standards

- Weld Joint Efficiency

Names	Joint types	NDT		
		100% test	Local test	No test
GB150	Butt weld of double-welded or butt weld of penetration weld corresponding to double-welded	1.0	0.85	/
	Butt weld of single-welded (with metal gasket)	0.9	0.80	/
ASME 规范	Butt weld of double-welded or butt weld of penetration weld corresponding to double-welded	1.0	0.75	0.70
	Butt weld of single-welded (with metal gasket)	0.9	0.80	0.65
	Butt weld of single-welded (without metal gasket)	/	/	0.60

# Comparison of GB and ASME Standards

- Design Formula and Table

Table 4 Comparison of designed formulas

Items	GB150	ASME Codes VIII/Division 1
Cylinder hull	$\delta = P_c D_i / (2[\sigma]t\phi - P_c)$	$t = PR / (SE - 0.6P)$ , circumferential stress $t = PR / (2SE + 0.6P)$ , longitudinal stress
Spherical Shell	$\delta = P_c D_i / (4[\sigma]t\phi - P_c)$	$t = PR / (2SE - 0.2P)$
Ellipse head	$\delta = P_c D_i / (2[\sigma]t\phi - 0.5P_c)$ standard type $\delta = KP_c D_i / (2[\sigma]t\phi - 0.5P_c)$ , non-standard tye	$t = PD / (2SE - 0.2P)$
Torispherical head	$\delta = MP_c R_i / (2[\sigma]t\phi - 0.5P_c)$	$t = 0.885PL / (SE - 0.1P)$
Hemispherical head	$\delta = QP_c D_i / (2[\sigma]t\phi - P_c)$	$t = PL / (2SE - 0.2P)$
Cone and taper head	$\delta = P_c D_c / (2[\sigma]t\phi - P_c) \cos\alpha$	$t = PD / [2\cos\alpha(SE - 0.6P)]$

# Comparison of GB and ASME Standards

- Vessel Openings and Table

Table 5 Comparison of opening dimensions

Items	GB150	ASME Codes VIII Division 1	
Opening on cylinder	When $D_i \leq 1500\text{mm}$ , the maximum diameter $d \leq D_i / 2$ , and $d \leq 520\text{mm}$	When $D_i \leq 1520\text{mm}$ , the maximum diameter $d \leq D_i / 2$ , and $d \leq 508\text{mm}$	Opening dimension could exceed the limit, but should be strengthened according to the big opening
	When $D_i > 1500\text{mm}$ , the maximum diameter $d \leq D_i / 3$ , and $d \leq 1000\text{mm}$	When $D_i > 1520\text{mm}$ , the maximum diameter $d \leq D_i / 3$ , and $d \leq 1000\text{mm}$	
Protruding head	$d \leq D_i / 2$	No limit for the opening dimension subject to the correctly strengthened	
Taper hull	$d \leq D_i / 3$		

# Comparison of GB and ASME Standards

- Chinese material : Not so systematic
- ASME : Systematic in ASME II
- Note:  $-$ Ve tolerance for Chinese Material is commonly 0.6 to 0.8 mm for SS; whereas in ASME, it is 0.25 mm



# Comparison of GB and ASME Standards

- Design Temperature, if it is below  $-20^{\circ}\text{C}$ , considered as LT vessel ( GB 150 Appendix C shall be applicable)
- ASME : Per UCS 66 etc to calculate MDMT of the material, and compare with vessel MDMT, for determination of Charpy Impact test requirement.

# Comparison of GB and ASME Standards

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- Welder Qualification
- GB 150: Control by Government ( Safety Surveillance Authority)
- ASME VIII : ASME authorized manufacturer per ASME IX

# Comparison of GB and ASME Standards

- Welder Examination
- GB 150: Basic theory + Welding skill
- ASME VIII : Welder Skill
- Certificates validity
- GB 150: 3 years ( re-test may be exempted if continuous engaged in welding work and below 50 years old).
- ASME VIII: Not that specific
- Re-qualification required : if not doing welding work for more than 6 months.

# Comparison of GB and ASME Standards

- Production Test Plates (**Test Specimen**)
- GB 150 specify:
  - Mobile type
  - DP > 10 MPa
  - Spherical storage tank welded in-situ
  - Tensile strength > 540 MPa
  - Client requirement
  - Low temp vessel
  - What about ASME vessel ?

# Comparison of GB and ASME Standards

Table 7 Comparison of NDT

Items	GB 150	ASME Codes VIII/Division 1
NDT personnel requirements	Should be subject to training and passed the examination in accordance with Qualification Codes for NDT personnel of Boilers and Pressure Vessels and holding the certificate	Trained, examined and assessed by the manufacture holding the ASME certificate or obtain the ASNT certificate
NDT ratio for weld	<p>①100% RT or UT</p> <p>②Local RT or UT, 50% (ferrite steel low temperature pressure vessel)</p> <p>③Local RT or UT, 20%</p>	<p>①100% RT</p> <p>②Sampling RT, one sampling for each 15.2m weld, and the minimum length of sampling film is 150mm for each</p>

# Comparison of GB and ASME Standards

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- Welding Repair
- Not more than 2 times (GB 150 ) on the same location
- By qualified welder as per approved WPS
- ASME: Repair shall be approved by AI before the repair.

# Comparison of GB and ASME Standards

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- PWHT: GB 150 is essentially same as ASME VIII
- Note: If Vessel is designed as per GB 150 Appendix C –LT Vessel, then PWHT is required if vessel wall thickness is above 16 mm.

# Comparison of GB and ASME Standards

- Pressure Test
- Duration: 30 mins at test pressure. Then reduce to 80 % for sufficient time for inspection work.

Table 8 Comparison of test pressure

Criterion	Hydraulic pressure test	Pneumatic pressure test
GB 150	$1.25P[\sigma] / [\sigma]t$	$1.15P[\sigma] / [\sigma]t$
JB4732	$1.25PSm/Stm$	$1.15PSm/Stm$
ASME Codes VIII/ Division 1	$1.3PS/St$	$1.1PS/St$



# Comparison of GB and ASME Standards

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- Documentation /Material Certification Levels
- Type: 3.1 B certificate ( or Type 3.1) as per EN 10204: 2004. This EN is in GB 9711.2 Appendix.
- Retention: 7 years (GB 150 )

# Comparison of GB and ASME Standards

- GB 50235 and ASME B31.3
- Material: Chinese standard / ASME II
- Low Temp : -20 C / -20 F
- Welding: Similar
- PWHT: 19 mm for CS ( same)
- NDT: 100 % on toxic and  $> 10$  MPa (GB)
- Hydrotest : Same, GB specify duration. Test pressure is 1.5 DP for 10 mins, then at DP for 30 mins.( For water medium)
- Test temp :  $> 5$  C to avoid brittle rupture

# Comparison of GB and ASME Standards

- SY- 0466-97: for gas pipeline
- Ho-Lo : 1.5 mm
- NDT
- 16 to 70 M Pa: 100 % UT + 100% RT
- 10 to 16 M Pa: 100% UT + 15 % RT
- 4 to 10 M Pa: 100 % UT + 10 % RT
- 1.6 to 4 M Pa: 100 % UT + 5 % RT

# Comparison of GB and ASME Standards

- SY 0402: Oil and Gas station / Plant
- Wind speed not suitable for welding is mentioned in the code.
- NDT
- $P > 16 \text{ M Pa}$ : 100 % RT
- 4 to 16 M Pa: 100 % UT + 10 % RT
- 1.6 to 4 M Pa: 100 % UT + 5 % RT
- $< 1.6 \text{ M Pa}$ : 50 % UT only

# Comparison of GB and ASME Standards

Chinese & ASME common material for PV

16 MnR	A516-70
C 0.20 Max	0.27-0.31
Mn 1.2 –1.6	0.85-1.2
P 0.030 max	0.035 max
S 0.020 max	0.035 max

16 MnR can have micro-element such as Cr, Ni, Cu each less than 0.30 %, total less than 0.60 %.

Ref: handout given during seminar

# Comparison of GB and ASME Standards

## Mechanical Properties Comparison

16 MnR	A 516-70
Tensile 510-640 M Pa (for 6 to 16 mm)	485-520 M Pa
Yield 345 M Pa Min ( for 6 to 16 mm)	260 M Pa
Elongation 20-21%	17-21%
Impact test 27J at -20C	S5

# Comparison of GB and ASME Standards

- GB and ASME B31.8 Pipeline Code Comparison

1. Basic Reference International Code

**GB 50251-1994**

2. ASME B31.8

# Comparison of GB and ASME Standards

	GB 50251	ASME 31.8	Remarks
Zone 1	<b>&lt; or =15 (houses)</b>	<b>&lt; or = 10</b>	<b>F = 0.72</b>
Zone 2	<b>&lt; or = 100</b>	<b>&lt; 46</b>	<b>F = 0.60</b>
Zone 3	<b>&gt; 100</b>	<b>&gt; or = 46</b>	<b>F = 0.50</b>
Zone 4	<b>plant</b>	<b>plant</b>	<b>F = 0.40</b>



# Comparison of GB and ASME Standards

	GB 50251	ASME B31.8	Remarks
<b>3.Casing requirement</b>	<b>For Class I and II highway and railway</b>		
<b>4. Material</b>	<b>Follow API 5L with:</b> <b>C &lt; 0.25 %</b> <b>CE &lt; 0.45 %</b> <b>S &lt; 0.035 %</b> <b>P &lt; 0.04 %</b>	<b>Follow API 5 L in old revision.</b>  <b>Note: Shell follows ISO 3183 in new revision</b>  <b>C and CE etc are modified for sour service</b>	<b>Suggest to limit carbon content</b> <b>P, S and CE as per Some Oil company std.</b>  <b>Need to meet sour gas requirement?</b>

# Comparison of GB and ASME Standards

	GB 50251	ASME B31.8	Remarks
<b>5. Low Temperature classification</b>	<b>Less than minus 20C</b>	<b>For Temperature below -20 F</b>	<b>To clarify and specify impact test.</b>
<b>6. Welding</b>	<b>Undercut is not totally prohibited</b>	<b>Same. Note:undercut is not allowed for low temp service for some oil companies</b>	<b>Suggest that undercut is not allowed, to specify in spec.</b>

# Comparison of GB and ASME Standards

	GB 50251	ASME B31.8	Remarks
<b>7. Pipeline valves</b>	<b>GB standard for equivalent API 6D valve??</b>	<b>API 6D is required.</b>	<b>API 6D is required, site test required. To specify in spec.</b>
<b>8. PWHT</b>	<b>thickness &gt; 32 mm</b>	<b>Thickness &gt; 32 mm</b>	

# Comparison of GB and ASME Standards

	GB 50251	ASME B31.8	Remarks
<b>9. NDT- RT</b>	<b>Zone 1 : 10 % Zone 2 : 15 % Zone 3 : 40 % Zone 4 : 75 %</b>	<b>100% ??</b>	UT or RT
<b>10. Cleaning</b>	<b>2 times of pigging ( min). Water Flushing : &gt;1.5 m/s Air cleaning: &gt; 20 m/s</b>		

# Comparison of GB and ASME Standards

	GB 50251	ASME B31.8	Remarks
<b>11. Hydrotest</b>	Zone 1 : x1.10 Zone 2 : x1.25 Zone 3 : x 1.40 Zone 4 : x 1.50	to 90 % of SMYS	<b>To clarify</b> <b>SY 0401 also mentioned</b> <b>max test pressure to 0.9</b> <b>SMYS</b>
<b>12. Hydrotest duration</b>	4 hours strength test- stabilization 24 hours gas tightness test Air test allowed for zone 1 and 2	4 hrs at hydrotest pressure and also 24 hours at 80 % hydrotest pressure OR: 24 hours at full hydrotest pressure	<b>To clarify</b> <b>Generally, similar</b>

# Comparison of GB and ASME Standards

## GB 50235-1997 and ASME B31.3 Comparison

Description	GB 50235-1997	ASME	Remarks
1. Basic Reference International Code	ASME B31.3	ASME B31.3	Same
2. Categorization	Type A Type B Type C Type D	Severe Cyclic Category M Category Normal Cat D- Non Toxic etc	
3. Material	Chinese Material	Follow API / ASTM/ SB etc	Chinese material follows ISO 3183 Mainly Chinese Standards
4. Piping Components	Bend ( t > 19 mm)  Valves required seat testing before installation, std forms provided	Bend ( t > 19 mm)  Not specifically mentioned	Heat treatment required ( 900 C)
5. Low Temperature classification	Less than -20C	Less than -20 F ( -29 C)	To check impact test requirement

# Comparison of GB and ASME Standards

6. Welding	Specify min distance between welds e.g OD > 150 mm, it is 150 mm OD < 150 mm, it is 'OD'	Not in details	Basically follows ASME IX and good engineering practice on weld joint edge cleaning
	Hi-Lo : lesser of 0.1 t or 2 mm for CS TIG for root pass ( section 5.0.11)		GB 50236-98 follows ASME IX generally.
7. Fit-up/ Assembly	Typical fit-up details provided for CS, Al and Ti pipes	Not in ASME B31.3, bot refer in ASME IX , <a href="#">Approved WPS etc</a>	
8. PWHT	thickness > 19 mm for CS	Thickness > 19 mm for CS	Same
9. NDT	<a href="#">VT:</a> <a href="#">MPI / DP:</a> <a href="#">RT : 100 % on toxic and HP (&gt; 10 Mpa)</a> <a href="#">UT: as substitute for RT, approval req'd</a>		<a href="#">Ref GB 50235 section 7 for details</a> <a href="#">e.g 100% RT for :</a> <a href="#">Toxic</a> <a href="#">P&gt;10 M Pa or 4 Mpa when T&gt;400C</a> <a href="#">Temp &lt; -29 C</a> <a href="#">Technical Spec</a>
10. Cleaning	Required to submit procedure <a href="#">for approval, record req'd after cleaning</a>	No specifically mentioned	Ref GB 50235 section 8

# Comparison of GB and ASME Standards

	brittle materials) Water: 1.5 DP, temp > 5 C Cl 2 content < 25 ppm for SS pipe. Weld Joint: not painted,	the material yield point. Min duration: 10 mins Cl 2 < 50 ppm Weld Joint: may be painted	30 mins at DP. Follows B 31.3, pneumatic not allowed generally.
12 Golden joints	100 % RT on butt welds, 100 % MPI or DP on branch welds.	Same. In progress examination and 100 % RT or UT.	GB follows ASME B 31.3
13 Others			
Flange Rating	both American and US systems were used. Mostly follows European PN 1.6 is 1.6 M Pa		Careful when purchase flanges need to specify US or European system.
Piping -metallic	Schedule not commonly used. Follow GB 9711.2 etc which is similar to ISO 3183		Seamless, ERW, UOE, JCOE SSAW, LSAW etc
Piping- Non metallic	Trend toward the use of non-metallic is also increasing, PVC, GRE etc	Same	
Max wind sped for welding work	GMAW : 2.2 m/s SMAW : 8 m/s FCAW : 11 m/s		



# Comparison of GB and ASME Standards

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Thank You



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